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A Trap for Capturing Arthropods Crawling Up Tree Boles

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Abstract

A simple trap is described that captures arthropods as they crawl up tree boles. Constructed from metal funnels, plastic sandwich containers, and specimen cups, the traps can be assembled by one person at a rate of 5 to 6 per hour and installed in 2 to 3 minutes. Specimen collection required 15 to 20 seconds per trap. In 1993, three traps were placed on each tree. In 1994, a single trap per tree with a drift fence consisting of an aluminum band wrapped around the tree was used. Trap captures from four l-week samples collected in April, July, October, and January of each year were compared. Traps without drift fences captured arthropods in 63 different genera and an average of 16.3 arthropods per trap. Those with drift fences captured 122 different genera and 26.8 arthropods per trap. The traps captured arthropods from 18 orders. They were particularly effective for capturing spiders (Araneae), ants (Hymenoptera: Formicidae), and beetles (Coleoptera). In addition, the traps worked well in capturing the pine reproduction weevils, ***Hylobius pales*** (Herbst) and ***Pachylobius picivorus*** (Germar). The traps offer a simple, effective alternative for the study of arthropods that crawl up the bark of trees. They are easy to construct and install, allow quick sample recovery, and can be left unattended for several weeks without sample deterioration.

Keywords: Arthropod trap, bark surface, crawl trap, ***Hylobius pales, Pachylobius picivorus.***

Introduction

The tree bole or trunk is a major structural feature in forested landscapes that influences arthropod behavior and habits. Jackson (1979) characterized the bark as a "bedroom community" where arthropods lay eggs or overwinter but do little else. However, Moeed and Mead (1983) noted that tree trunks provide an important pathway for ground-dwelling and flightless arthropods to move to the canopy. To study arthropod use of tree boles in southern pine ecosystems, we needed a reusable trap that would be easy to install and maintain over an extended period.

Others have designed traps to capture arthropods crawling up the boles of trees (Funke 197 1, Klepzig and others 199 1, Mariani and Manuwal 1990, Moeed and Mead 1983). Most are similar in construction and rely on an upward directed wire screen skirt or drift fence wrapped around the bole and formed into a funnel at the top. The screen skirt or drift fence directs arthropods into a collection container. Funke's (I 97 1) traps differ, consisting of three to four interconnected cloth funnels. Although these traps are effective, we noted several drawbacks to using them on a large scale. These limitations include high initial construction and/or installation time and slow sample recovery from the collection container.

We designed and tested a trunk or crawl trap that is easy to construct and install and requires only a few seconds for sample recovery and preparation for the next collection period. In addition, with an appropriate preservative in the collection container, the traps can be left unattended for several weeks without specimen deterioration. We report here the richness and abundance of arthropods captured in the traps alone and in conjunction with a drift fence.

Materials and Methods

Materials for trap construction include a 5.7-L tin funnel (McMaster-Carr Co., Atlanta, GA), a 470-mL capacity sandwich container (Rubbennaid Co.), a 120-mL

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polypropylene specimen cup with a screw cap, sand, Nybco Spra Glu adhesive (Kankakee, IL), Fluon (Northern Products Co., Woonsocket, RI), flat black spray enamel paint, solder, wire, and screws.

We modified the tin funnel by cutting the outlet off to a length of 1.5 cm, resulting in an outlet diameter of 2.5 cm. A triangular-shaped section, 16-cm wide along the lip of the funnel and tapering to a round tip (2-cm diameter) ending 3 cm below the base of the spout, was cut out of the side of the funnel. The edges along the triangular cutout were bent to form a flat surface (5-mm wide) to aid in sealing the funnel to the bark (fig. 1A). Four holes (2-mm diameter) were drilled into the funnel near the edge of the triangular cutout, and 10-cm long pieces of wire (1 -mm diameter) were inserted into each hole (fig. 1B). Both ends of the wires were formed into loops to prevent them from slipping out of the holes and to use in securing the funnels to the trees (fig. 2A). We sprayed the inside surface of the funnel with glue and sprinkled sand on the wet glue to provide a rough surface for the arthropods to crawl on. We painted the entire funnel black to reduce the risk that the shiny tin surface would attract or repel arthropods.

We modified the sandwich container by drilling one hole (3.5 cm diameter) in a corner (4.75 cm from the container center), and a second hole (2.9-cm diameter) in the opposite comer (3.25 cm from the center) (fig. 1B). A 2.9-cm diameter hole was drilled through the lid of the specimen cup. The cup lid was then attached to the sandwich container beneath the 2.9-cm diameter hole with two, short, pan head screws. The outlet of the funnel was inserted through the larger hole in the container, and two drops of solder were placed on the funnel outlet (inside the container) to keep the sandwich container from slipping off. The inside of the sandwich container was coated with Fluon, a polytetrafluoroethylene suspension, to create a slippery surface that arthropods could not crawl up.

The bark where the traps were to be attached was scraped smooth without injuring the tree, and the traps were positioned so the edge of the triangular cutout in the funnel was against the bark surface (figs. 2A and 2B). Roofing nails (3-cm long) hammered into the bark through the wire loops held the traps in place. The funnel/hark interface was sealed with clear 100-percent silicone caulk to prevent arthropod escape. The specimen cups, filled with a concentrated NaCl solution and l-percent formaldehyde, were screwed onto the cup lid. Arthropods crawled up the tree, through the funnel, and into the sandwich container where they eventually fell into the specimen cup.

We conducted two trials with the traps on the Savannah River Site near Aiken, SC. In 1993, the traps were attached to the boles of 50- to 60-year-old longleaf pines, *Pinus palustris* L. Three traps were spaced equidistant around the circumference of the tree bole approximately 1.5 m above the ground (fig. 2B). Traps were placed on 1 tree in each of 8 widely scattered longleaf pine stands resulting in a total of 24 traps. The traps were checked weekly for 1 year, and all arthropods captured were identified to genus or the lowest taxonomic level possible.

In 1994, eight stands of mature longleaf pine were selected, and five trees within 0. l-ha plots in each stand were fitted with one trap each (40 traps). In addition to the trap, a barrier constructed of IO-cm wide aluminum sheet metal coated with Fluon was added (fig. 2A). The barrier was wrapped around each tree just below the funnels so the upper edge of the barrier touched the bottom of the funnel. The bark beneath the barrier was scraped smooth to prevent arthropods from going under it. The barrier was held in place with two roofing nails, and the lower edge was sealed to the bark with silicone caulk to further reduce the likelihood of arthropods going under it. The barrier partially encircled the tree and an 1 1 - to 12-cm wide gap opened into the mouth of the funnel. Arthropods crawling up the tree followed the edge of the barrier to the gap and then continued up into the funnel.

We operated the traps in the second trial for 1 year. However, we only identified all of the arthropods captured in four 1-week samples collected in April, July, October, and January. Therefore, we selected the samples for those same weeks from the 1993 trial for comparison. In each trial, we combined the data on arthropods captured. However, to permit direct comparison of trap effectiveness between the two trials, we divided the numbers caught by the number of traps used in each experiment.

Results and Discussion

The traps were easy to construct. We estimate that one person could construct five to six traps per hour, and two people working together could install one trap with a drift fence in 2 to 3 minutes. Ultraviolet (UV) light did deteriorate the plastic sandwich containers. Coating the containers with a UV protectant might reduce this problem. Sample collection involved removing the collection cup from the trap and screwing on a fresh cup and only took a few seconds per trap. Occasionally, specimens such as large grasshoppers, preying mantids, or walking sticks became stuck in the sandwich container and failed to fall into the specimen cup. They were collected by removing the lid of the container.

The traps with a drift fence captured a greater diversity of arthropods and more individuals per taxon than traps without the barrier. Funnel traps with a barrier captured 122 different taxa and an average of 26.8 arthropods per trap during the 4

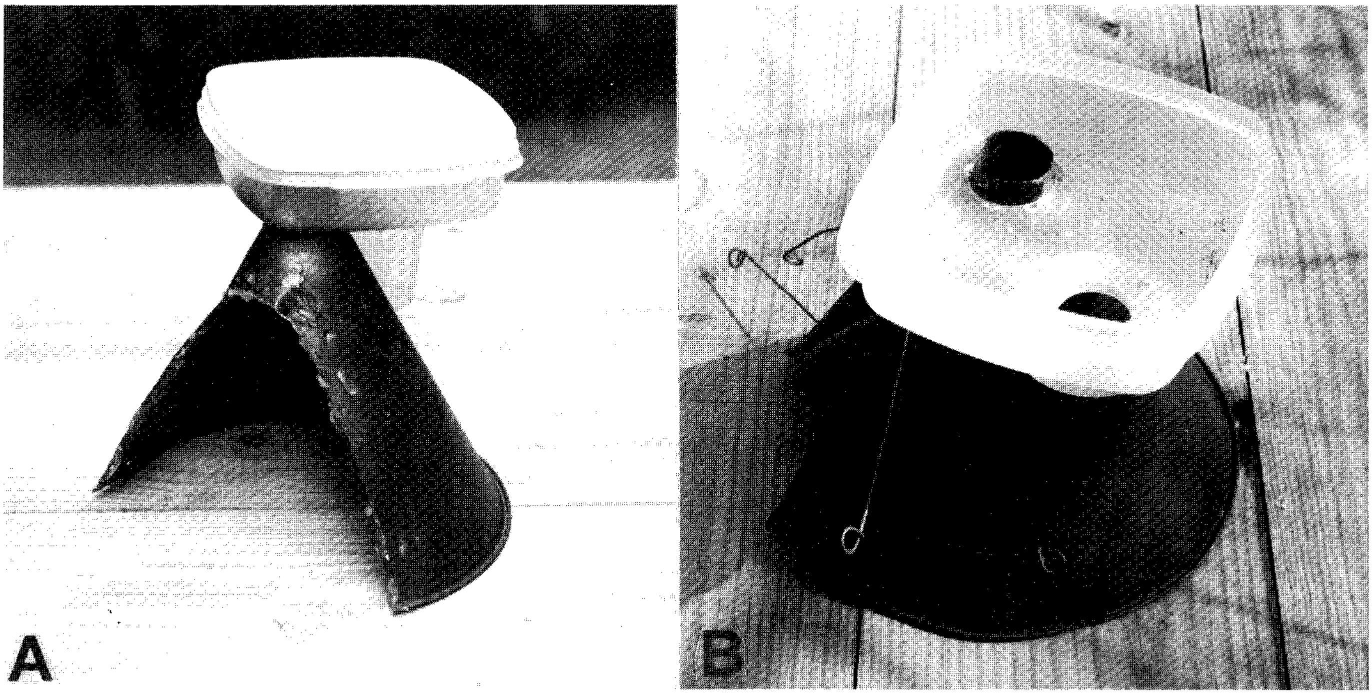

Figure 1-A simple trap for capturing arthropods that crawl up the bark of trees. (A) The trap consists of a modified metal funnel, sandwich storage container, and a plastic specimen cup. (B) The side of the funnel is cut out so the funnel can be fitted to the side of the tree.

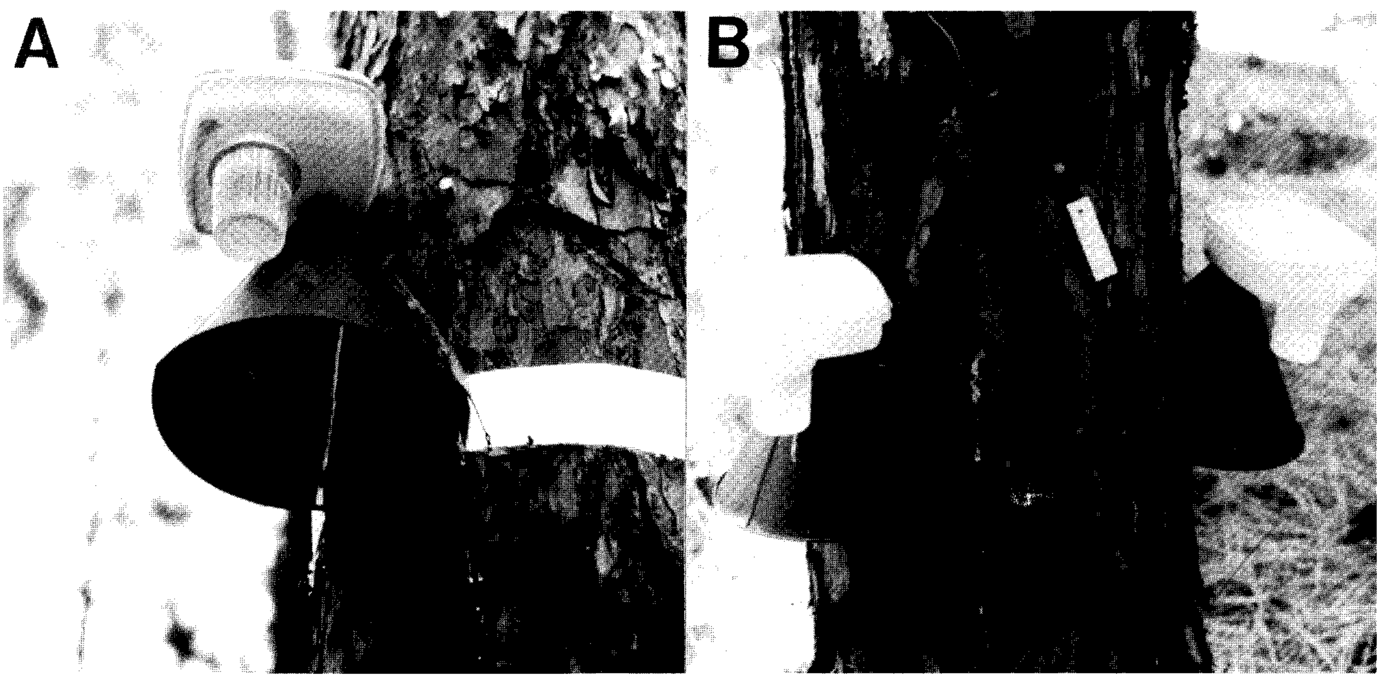

Figure 2—Two configurations of the crawl trap. (A) One using a single trap with a drift fence constructed from aluminum sheet metal and sealed to the bark with silicone caulk and (B) a second around the circumference of the tree bole.

weeks tested; those without barriers captured only 63 different arthropods and an average of 16.3 arthropods per trap.

Table 1 shows the average number of specimens of each genus or taxon captured per trap. In almost every case, the traps with the barriers caught more than those without barriers. The traps were particularly effective in capturing hunting spiders (Araneae), beetles (Coleoptera), and Hymenoptera, especially ants (Formicidae). For some taxa, the traps without barriers were as effective as those with barriers (for example, ***Crematogaster*** spp.). Among the Coleoptera, the traps were effective for capturing the pine reproduction weevils, ***Hylobius*** pales (Herbst) and ***Pachylobius picivorus*** (Germar) and Tenebrionidae in the genus ***Helops.***

Although the two trials were conducted in different years, the large increase in arthropod taxa and the general increase in the numbers of individuals captured in 1994 were probably not the result of an overall increase in arthropod abundance that year. Instead, using a drift fence with the traps apparently increases the trap captures. In addition, this method reduces the amount of labor involved to construct enough traps for a given study.

Moeed and Mead (1983) conducted an extensive study of invertebrates on tree trunks in New Zealand. They operated 20 traps on 5 tree species continuously for 1% years and captured approximately 138 different species. One-half of their traps captured arthropods crawling down the tree. Although directly comparing the two studies is not possible because location, forest type, trapping intensity, and taxonomic intensity of the various orders are different, arthropod richness comparisons give some indication of a trap's abilities to capture various groups. We captured 122 different genera with 40 traps operated during four 1 -week periods. The types of arthropods captured were similar in the two studies.

In our second trial, using traps with drift fences, we captured ***29 Hylobius*** sp. and 102 ***Pachylobius*** sp. weevils during 4 weeks of trapping. In previous studies, baited crawl traps or basal trunk traps were used to sample reproduction weevils (Klepzig and others 1991, Maki 1969, Raffa and Hall 1988). Although we were trying to avoid attraction of specific arthropods to our traps, the relatively large numbers of reproduction weevils captured is interesting and suggests that our tunnel traps could easily be used in studies of these and other arboreal weevils.

The funnel traps are effective in capturing a variety of arthropods. They are simple to construct and install, sample collection is easy, and the traps are easily removed and reused. They can also be adapted for use on small trees (5- to 10-cm d.b.h.) by cutting a smaller section from the side of the funnel. In addition, traps can be left unattended for 4 weeks without deterioration of the specimens, because the collection containers prevent dilution of the preservative by rainfall. These funnel traps are readily adaptable to a wide variety of situations.

Acknowledgments

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Literature Cited

Funke, W. 197 1. Food and energy turnover of leaf-eating insects and their influence on primary production. In: Ellenberg, H., ed. Ecological studies: integrating experimental ecology. New York: Springer Berlin Heidelberg. 8 l-93.

Jackson, J.A. 1979. Tree surfaces as foraging substrates for insectivorous birds. In: Dickson, J.G.; Conner, R.N.; Fleet, R.R.; Jackson, J.A., eds. The role of insectivorous bii in forest ecosystems. New York: Academic Press: 69-93.

Klepzig, K.D.; Raffa, K.F.; Smalley, E.B. 199 1. Association of an insect-fungal complex with red pine decline in Wisconsin. Forest Science. 38: 1119-l 139.

Maki, J.R. 1969. Aspect of the ecology and biology of the red pine root collar weevil, ***Hylobius rudicis*** Buchanan, in Michigan. East Lansing: Michigan State University. Ph.D. dissertation.

Mariani, Jina M.; Manuwal, David A. 1990. Factors influencing brown creeper ***(Certhia americana)*** abundance patterns in the southern Washington Cascade Range. In: Morrison, Michael L.; Ralph, C. John; Verner, Jared; Jehl, Joseph R. Jr., eds. Avian foraging: theory, methodology, and applications. Studies in Avian Biology. 13: 53-57.

Moeed, Abdul; Mead, M.J. 1983. Invertebrate fauna of our tree species in Orongorongo Valley, New Zealand, as revealed by trunk traps. New Zealand Journal of Ecology. 6: 39-53.

Raffa, Kenneth F.; Hall, David J. 1988. Seasonal occurrence of pine root collar weevil, ***Hylobius radicis*** (Coleoptera: Curculionidae), in red pine stands undergoing decline. Great Lakes Entomologist. 21: 69-74.

Table l-Mean number of arthropods captured per trap in funnel traps with and without drift fences

Order and family	Genus	Mean number of arthropods per trap: Traps with drift fence (40 traps)	Mean number of arthropods per trap: Traps without drift fences (24 traps)
Araneae			
Anyphaenidae	*Anyphaena*	0.38	0.13
Araneidae	*Araneus*	.03	0
Clubionidae	*Castianeira*	.08	0
	Trachelas	.13	.08
Corinnidae	*Phrurotimpus*	.05	0
Ctenizidae	*Myrmeciophilia*	0	.25
Gnaphosidae	*Gnaphosa*	0	.08
	Herpyllus	1.40	.25
	Zelotes	.975	.04
Linyphiidae	Unknown	2.52	.58
	Ceraticelus	.03	.13
	Grammonota	.03	0
	Walckenaeria	.33	.08
Lycosidae	Unknown	.03	0
	Lycosa	.13	.08
	Pardosa	.58	.04
	Schizocosa	.45	.08
Mimetidae	*Mimetus*	0	.04
Oonopidae	*Gamasomorpha*	.03	.08
Oxyopidae	Unknown	.05	0
Philodromidae	*Philodromus*	.35	.17
Salticidae	*Eris*	.05	0
	Habrocestum	.03	0
	Metacyrba	.18	0
	Metaphidippus	0	.04
	Phidippus	.20	.04
	Sitticus	.03	0
	Thiodina	.18	0
Segestriidae	*Ariadna*	.05	0
Theridiidae	*Theridion*	.03	.04
Thomisidae	*Coriarachne*	.43	.04
	Tmarus	.03	0
	Xysticus	.08	0
Chelonethida		0	.04
Coleoptera			
Alleculidae	*Lobopoda*	.05	0
Buprestidae	*Chalcophora*	.03	0
Carabidae	*Dromius*	.05	0
	Pterostichus	.23	0
Cerambycidae	*Ecyrus*	.03	0
Chrysomelidae	*Metachroma*	.03	0
Curculionidae	*Cercopeus*	.03	0
	Chalcodermus	.05	0
	Cossonus	0	.04
	Curculio	.03	0

Table l-Mean number of arthropods captured per trap in funnel traps with and without drift fences (continued)

Order and family	Genus	Mean number of arthropods per trap: Traps with drift fence (40 traps)	Traps without drift fences (24 traps)
	Hylobius	.73	.38
	Pachylobius	2.55	.33
	Pandeleteius	.03	0
	Pissodes	0	.04
Elateridae	*Ampedus*	.03	0
	Glyphonyx	.03	0
	Heteroderes	.03	0
	Megapenthes	.03	0
	Melanotus	.03	0
Endomychidae	*Stenotarsus*	.03	0
Leptodiridae	*Ptomaphagus*	.03	0
Meloidae	*Zonitis*	.03	0
Melyridae	*Attalus*	.03	0
Monommidae	*Hyporhagus*	.13	0
Mordellidae	*Glipodes*	.03	0
Nitidulidae	*Carpophilus*	.03	0
Scarabaeidae	*Diplotaxis*	.03	0
	Phyllophaga	.05	
Scolytidae	*Ips*	0	.04
Staphylinidae	Unknown	.08	.13
Tenebrionidae	*Helops*	.90	0
	Strongylium	.03	0
Trogositidae	Unknown	.05	0
Diplopoda	Unknown	.15	.08
Diptera			
Asilidae	*Philonicus*	.03	0
Aulacigastridae	*Aulacigaster*	.03	0
Cecidomyiidae	Unknown	.43	.04
	Porricondyla	0	.17
Ceratopogonidae	Unknown	.03	0
Chironomidae	Unknown	.03	0
	Micropsectra	0	.04
Culicidae	*Orthopodomyia*	0	.08
Drosophilidae	Unknown	0	.08
Muscidae	*Muscina*	.05	0
Mycetophilidae	*Exechiopsis*	0	.13
	Orfelia	0	.08
Phoridae	*Megaselia*	.05	0
Tachinidae	*Velocia*	0	.04
Tipulidae	Unknown	0	.08
Geophilomorpha	Unknown	.03	0
Hemiptera	Unknown	.05	0
Largidae	*Largus*	.20	.08
Miridae	*Phytocoris*	.78	.29
Pentatomidae	*Brochymena*	.38	0
	Euthyrhynchus	.05	.04

Table l-Mean number of arthropods captured per trap in funnel traps with and without drift fences (continued)

Order and family	Genus	Mean number of arthropods per trap: Traps with drift fence (40 traps)	Traps without drift fences (24 traps)
Reduviidae	*Melanolestes*	.03	0
	Pselliopus	.03	0
Tingidae	Unknown	.03	0
Homoptera			
Achilidae	*Epiptera*	.03	0
Aphididae	Unknown	0	.29
Cicadellidae	Unknown	.03	.04
Cixiidae	Unknown	.05	.04
	Oliarus	.08	0
Flatidae	*Catonia*	.03	0
Issidae	*Thionia*	.10	0
Hymenoptera			
Bethylidae	*Epyris*	.03	0
Chalcididae	*Spilochalcis*	0	.04
Encyrtidae	Unknown	.03	0
Evaniidae	*Hyptia*	.03	0
Formicidae	*Aphaenogaster*	0	.04
	Camponotus	.58	.33
	Crematogaster	3.27	8.29
	Forelius	0	.50
	Formica	.35	.04
	Hypoponera	.05	.04
	Iridomyrmex	.08	0
	Leptothorax	.03	0
	Myrmecina	.03	0
	Paratrechina	0	.29
	Pheidole	.05	0
	Prenolepis	1.00	.17
	Solenopsis	.05	.04
	Tetramorium	.03	.08
Mutillidae	*Dasymutilla*	.28	0
	Photomorphus	.10	0
	Pseudomethoca	.08	.04
	Sphaerophthalma	.03	0
Pamphiliidae	*Acantholyda*	.03	0
Pompilidae	*Ageniella*	0	.04
	Allaporus	.03	0
	Auplopus	.03	0
	Psorthaspis	.03	0
Scelionidae	*Gryon*	.03	0
Sphecidae	*Sphex*	.05	0
Vespidae	*Euodynerus*	.03	0
Lepidoptera			
Gelechiidae	Unknown	0	.04
Geometridae	Unknown	.30	0
Noctuidae	Unknown	.10	.04

Table 1—Mean number of arthropods captured per trap in funnel traps with and without drift fences (continued)

Order and family	Genus	Mean number of arthropods per trap: Traps with drift fence (40 traps)	Mean number of arthropods per trap: Traps without drift fences (24 traps)
Tineidae	Unknown	.03	0
Neuroptera			
Chrysopidae	*Chrysopa*	0	.04
Orthoptera			
Acrididae	*Melanoplus*	.05	0
Blattidae	*Parcoblatta*	.33	.17
Gryllacrididae	*Hippoclamia*	.03	0
Gryllidae	Unknown	.20	.13
	Cycloptilum	.15	0
Tettigoniidae	Unknown	.20	0
Phalangida	Unknown	.33	.17
Plecoptera			
Leuctridae	*Leuctra*	0	.13
Psocoptera			
Lepidopsocidae	Unknown	2.02	.71
Scolopendromorpha			
Cryptopidae	Unknown	.03	0
Thysanura			
Lepismatidae	*Thermobia*	.13	0

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